

SWIMMING POOL CLEANING APPARATUS

Cross-Reference to Related Applications

[0001] This application claims priority to Provisional Application No. 60/396,208 for Swimming Pool Cleaning Apparatus and Method, filed July 16, 2002, the disclosure of which is incorporated herein by reference in its entirety.

Field of the Invention

[0002] The present invention generally relates to self propelled swimming pool cleaners for cleaning submerged surfaces, and more particularly to a swimming pool cleaning apparatus incorporating a flow control valve for establishing intermittent flow of a fluid through the cleaner for causing the cleaner to travel across the surface to be cleaned.

Background of the Invention

[0003] Submersible pool cleaners employing oscillating valves within a housing and flexible discs engaging the surface to be cleaned are generally well known, as illustrated by way of example with reference to U.S. Patent Nos. 4,023,227 to Chauvier and 4,351,077 to Hofmann. What is also generally known are the problems associated with debris clogging fluid flow passages, wearing cleaner components rendering the cleaner ineffective or unusable, and the difficulty for a consumer attempting to replace such worn components. Embodiments of the present invention herein described provide an efficiently run submersible cleaner which includes components that are easily replaceable by the consumer.

Summary of the Invention

[0004] A submersible cleaner in keeping with the teachings of the present invention may include a housing moveable along a submerged surface to be cleaned through fluid flow past a valve operable for moving the cleaner. The

housing may include a flow passage for a flow of fluid and debris from an inlet to an outlet with the fluid and debris constrained to flow through an opening defined within the passage. A wall may extend into the flow passage for defining the opening. A valve may be operable within the flow passage for interrupting fluid flow. A retractable element may be moveable between the valve and the wall for reducing a gap formed between them. The retractable element may be attached to either the valve or the wall, and may make slidable engagement.

[0005] A flexible plate may be carried proximate the inlet for engaging the surface to be cleaned. The flexible plate may be described to include an upper surface, an opposing lower surface for contacting the surface to be cleaned, and a periphery defined by a plurality of tongues radially extending about the periphery. Each of the plurality of tongues may include a lower surface portion for contacting the surface to be cleaned and a contouring portion in a spaced relation with the surface to be cleaned during operation of the apparatus, thus upwardly lifting an outer most periphery of the plate from the surface to be cleaned. A plurality of reinforcing elements may be integrally formed with the flexible plate for upwardly contouring the periphery from the surface to be cleaned. The reinforcing elements may include a rib that may be integrally formed with the upper surface of the flexible plate with the rib extending radially outward while confined within the periphery of the flexible plate. Alternatively, the reinforcing element may comprise a flange extending along the peripheral edge of the tongue, or yet other reinforcing styled elements.

Brief Description of the Drawings

[0006] Embodiments of the invention are described by way of example with reference to the accompanying drawings in which:

[0007] FIG. 1 is a left side perspective view of one embodiment of a swimming pool cleaner according to the present invention;

[0008] FIG. 2 is a right side elevation view of the cleaner of FIG. 1;

[0009] FIG. 3 is a partial cross section view of a pool cleaner illustrating fluid flow therethrough;

[0010] FIGS. 4 and 5 are partial cross section view of a housing portion of the embodiment of FIG. 3 illustrating an enlarged view of the oscillator valve in a seated position and an unseated position, respectively;

[0011] FIGS. 6 is an alternate embodiment of the valve in keeping with the teachings of the present invention;

[0012] FIG. 7 is a perspective view of a cover;

[0013] FIGS. 8 and 9 are perspective and side views of an embodiment of a valve;

[0014] FIG. 10 is a partial top view looking down on the valve carried within the housing;

[0015] FIG. 11 and 11A illustrate alternate embodiments having a retractable element carried by the valve and alternatively by a partition wall, respectively;

[0016] FIGS. 13-20 illustrate alternate embodiments of the valve operable with the retractable element;

[0017] FIG. 21 is a partial top view of one embodiment of a flexible plate;

[0018] FIG. 22 is a partial cross section elevation view taken through lines 22-22 of FIG. 21;

[0019] FIG. 23 is a partial top view of one embodiment of a flexible plate;

[0020] FIG. 24 is a partial cross section elevation view taken through lines 24-24 of FIG. 23;

[0021] FIG. 25 is a top plan view of one embodiment of a flexible plate;

[0022] FIG. 26 is a top plan view of an alternate embodiment of a flexible plate;

[0023] FIG. 27 is a partial top view of one embodiment of a flexible plate;

[0024] FIG. 28 is a partial cross section elevation view taken through lines 28-28 of FIG. 27;

[0025] FIG. 29 is a partial cross section view taken through lines 29-29 of FIG. 27;

[0026] FIG. 30 is an elevation and partial cross section view of a footpad of FIG. 1;

[0027] FIG. 31 is a side elevation and partial cross section view of the footpad of FIG. 30 illustrating front and rear lateral inlet ports; and

[0028] FIG. 32 is an elevation view of the footpad of FIG. 30 illustrating dual lateral inlet ports.

Detailed Description of the Preferred Embodiments

[0029] Embodiments of the present invention will now be described more fully with reference to the accompanying drawings. It will be understood by those skilled in the art that this invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numerals refer to like elements.

[0030] With reference initially to FIGS. 1 and 2, an embodiment of the present invention is herein described, by way of example, for a submersible swimming pool cleaner **10** having a housing **12** inclined toward a direction of travel, which housing carries a bumper **14** and weight **16** about a forward portion **18** with the bumper extending to left and right side portions **20, 22**. A float **24** is carried at an aft portion **26** for acting in conjunction with the weight **16** in allowing the cleaner **10** to fall to an upright position when dropping from a sidewall of a swimming pool. Vertical and horizontal bumper members **28, 30** are effective in having the cleaner avoid obstructions within the swimming pool, such as steps and sharp corners. The housing **12** further carries a flexible plate **32** via attachment with a footpad **34**.

[0031] The housing **12** includes a single flow passage **36** extending from an inlet **38** to an outlet **40** for a flow of fluid and debris through the passage, as described with reference to FIG. 3. A partition wall **42** extends into the single flow passage **36** such that the flow of fluid and debris (illustrated with arrows **44**) are constrained to pass through an opening **46** formed thereby and pass

to the outlet **40**, which outlet is adapted for connection to a suction source **48**. The flexible plate **32** is carried about the inlet **38** for engaging a submerged surface **50** to be cleaned. A valve **52** is pivotally carried within the flow passage **36** for interrupting fluid flow **44** through the passage during an oscillation of the valve between a seated position **54** for interrupting the flow to an unseated position **56** permitting the flow, as illustrated with reference to FIGS. 4 and 5. The valve **52** interrupts flow through the passage **36** resulting in a motion of the inclined housing **12** causing it to travel along the surface of the pool to be cleaned, the valve thus acting as the "motor" for the pool cleaner. With continued reference to FIG. 3, a suction of the fluid through the flow passage **36** causes an oscillating of the valve between the seated and the unseated positions and a resulting movement of the cleaner **10** across the submerged surface **50**.

[0032] With continued reference to FIGS. 3-5, a retractable element **58** is moveable between a valve distal end **60** and a surface **62** of the partition wall **42** for reducing a gap **64** formed between them, thus substantially limiting the flow of the fluid and debris to only one side **66** of the valve **52**. The retractable element **58** may be dimensioned such that the fluid flow through the passage **36** causes the retractable element to have slidably engagement between the valve distal end **60** and the surface **62** of the partition wall **42** during the oscillation of the valve, as illustrated with reference again to FIGS. 4 and 5, or alternatively may fully close or simply reduce the size of the gap **64**, as illustrated with reference to FIG. 6.

[0033] With reference again to FIGS. 1-5, the single flow passage **36** may be defined by opposing top and bottom walls **68**, **70** in combination with opposing left and right sidewalls **72**, **74**, wherein the distal end **60** of the valve **52** contacts the bottom wall **70** in the seated position **54** and oscillates between the seated position and a stop **76** formed with the distal end **60** for contacting the top wall **68**.

[0034] As illustrated with reference again to FIGS. 1-5, an access opening **78** within the top wall **68** provides entry into the housing **12** and the flow passage

36. A detachable cover **80** encloses the opening **78**. Access to the flow passage provides a convenience when clearing out debris lodged therein or replacing the valve, by way of example. In one embodiment of the cleaner, as herein described by way of example, the partition wall **42** is integrally formed with the cover **80**, as further illustrated with reference to FIG. 7. The cover **80** includes a lock **82** and tab **84** located at ends of the cover for securing the cover to the housing **12** for covering the opening **78**. A pivot pin **86** is carried by the housing **12** for pivotal connection with a proximal end **88** of the valve **52**. As illustrated with reference again to FIGS. 4 and 5, the valve **52** may be constructed to include an elongate arm **90** having the proximal end **88** for connection to the pivot pin **86**. A head portion **92** is located at the valve distal end **60**. The distal end **60** is carried within the passage **36** upstream the proximal end **88**. In the embodiment illustrated with reference to FIGS. 4 and 5, by way of example, the head portion **92** includes a slot **94** for slidably receiving the retractable element **58**. One embodiment of the retractable element **58** includes a slit **96** that is operable with a pin **98** carried within the slot **94**, as illustrated with reference to FIGS. 8 and 9. Flexible side edges **100** extend along the longitudinal sides of the valve **52** for minimizing side gaps **102** on the sides of the valve and for providing a close fit, as further illustrated with reference to FIG. 10, thus enhancing control of the fluid flow along the one side **66** of the valve **52**, as earlier described with reference to FIGS. 3-5.

[0035] Alternate embodiments keeping within the teachings of the present invention, may include by way of example, the head portion **92** having a protrusion **104** extending radially outward from the valve distal end **60** for slidably receiving the retractable element **58**, as illustrated with reference to FIG. 11. Further, the partition wall **42** may include a slot **106** extending for slidably receiving the retractable element **58**, as illustrated with reference to FIG. 12. Yet further, the partition wall **42** may include a protrusion **108** extending outward toward the valve **52** for slidably receiving the retractable element **58**, as illustrated by way of further example with reference to FIG. 11A. As herein illustrated, the retractable element **58** may have various

shapes and may be attached to the valve **52** or to the partition wall **42** without deviating from the teachings of the present invention, and may or may not fully close the gap **64**, as illustrated with reference to FIGS. 13-20.

[0036] With reference to FIGS. 19 and 20, by way of example, the generally circular cross sectional shape of the retractable element **58** and carried within a generally arcuate shape for the slot **94** supports a rolling motion for the retractable element during movement of the head portion **92**, thus reducing wear of the surface and element while remaining effective in directing fluid flow to the one side **66** of the valve **52**. The retractable element **58** is movably carried within the slot **94** making continuous contact with the **62** of the partition wall **42** or in close proximity as herein described. With reference again to FIGS. 6, 12, and 17, an embodiment of the valve **52** includes the head portion **92** having an angled slot **94** tapering from outside toward a slotted hole **95**, or alternatively having the tapered slot within the partition wall as illustrated with reference to FIG. 18. The head contact element includes an elongate portion having one end extending out of the slot **94** and an opposing end having a bulbous portion for a sliding movement within the hole **95**. Such an embodiment allows the retractable element **58** to be secured within the slot **94** during installation and easily held therein during assembly of the valve. Further, a flexible arm portion **109** may be provided as a shock buffer that results in reducing noise generated by the oscillating valve **52**, as illustrated with reference again to FIG. 6.

[0037] With reference again to FIGS. 1-3, the flexible plate **32** may be described as having an upper surface **110** and an opposing lower surface **112** for contacting the surface to be cleaned **50**. A periphery **114** of the plate **32** includes a plurality of tongues **116** radially extending thereabout. Each tongue **116** includes a lower surface portion **118** for contacting the surface to be cleaned **50** and a contoured portion **120** in a spaced relation with the surface to be cleaned during operation of the cleaner **10**, as illustrated with reference again to FIG. 3, and to FIGS. 21 and 22, the outer most peripheral portion of the plate being upwardly lifted from the surface to be cleaned. In one

embodiment, as herein illustrated, a rib **122** is integrally formed with the upper surface **110** of the flexible plate **32** at the tongue **116**. The rib **122** reinforces the tongue **116** for securing the contoured portion **120** in the convex shape. Alternate reinforcing element shapes may be formed with the flexible plate **32** for upwardly contouring the periphery **114** upwardly from the surface to be cleaned **50**, including a flange **124** extending along a peripheral edge of the tongue, as illustrated by way of example with reference to FIGS. 23 and 24.

[0038] As illustrates with reference again to FIG. 2 and to FIG. 25, embodiments of the plate **32** may include slots **126** radially extending from a center **128** of the plate. The slot **126** herein described is tapered so as to provide a diminishing gap as the taper extends radially outward from the center **128**. Alternatively, the plate **32** may include a slit **130**, as illustrated with reference again to FIGS. 22 and 24. Yet further, a combination of tapered slot **126** and slit **130** may be formed within the plate **32**, as illustrated with reference to FIG. 26, such slots and slits extending radially outward from the center **128** of the plate **32** provide added flexibility to the flexible plate **32** and improved maneuverability over contours within the surface to be cleaned **50**. A plurality of slots or slit may be symmetrically located as herein illustrated or located as desired for surface conditions.

[0039] By way of further example, and as illustrated with reference again to FIG. 25, the plurality of slots may extend along a first imaginary line **132** centrally positioned between second imaginary lines **134** passing centrally through each of the plurality of tongues **116**. Further, the plate **32** may include grooves **136** within the lower surface **112** and extending radially outward for the center **128**. As illustrated, the grooves **136** may extend only partially between the center **128** and the periphery **114** of the plate **32**.

[0040] Pleats **138** provide yet another alternative for adding flexibility to the plate **32**, as illustrated with reference FIGS. 27-29. Each of a plurality of pleats **138** extending radially from the center **128** forms a groove **140** within the lower surface **112** and a protrusion **142** in the upper surface **110**.

[0041] With reference to FIG. 26, by way of example, the plate **32** may include a plurality of holes **144** extending from the upper surface **110** to the lower surface **112** for modifying a suction provided by the flexible plate during operation of the cleaner **10** with the suction source.

[0042] As earlier described with reference to FIGS. 1-3, the cleaner **10** herein described by way of example, includes a foot pad **34** which carries the plate **32**. The foot pad **34** is attached to a flange **146** at the inlet **38** of the housing **12** as further illustrated with reference to FIG. 30. The footpad **34** is attached to the housing **12** and the flexible plate **32**, and easily replaced by the consumer. As illustrated with reference to FIGS. 31 and 32 using arrows, fluid flow passes through openings within the footpad above the plate and below for providing an effective cleaning of debris from the surface to be cleaned. As illustrated with reference again to FIG. 1-3, a hose connector **148** is carried at the outlet **40** of the housing **12**. Under the influence of the vacuum source **48**, typically a pump, a flexible hose **150** connected to the connector **148** causes fluid and debris to flow through the housing **12**.

[0043] As illustrated with reference again to FIGS. 1-3, one embodiment of the hose connector **148** includes a swivel portion **152**, nut portion **154** and collar **156** for providing a swivel connection to the hose **150**. Such a combination permits easy replacement of parts. A key **158** is carried by the collar **156** to fix the bumper **14** in a forward position.

[0044] Various embodiments of the present invention have been herein described in the drawings and specification, by way of example. Although specific terminology was employed, the terms are used in a descriptive sense only and not for purposes of limitation. The invention has been described in detail with specific reference to these illustrated embodiments. However, it will be apparent that various modifications and changes may be made while keeping within the teachings and scope of the invention as described in the foregoing specification and as defined in claims.